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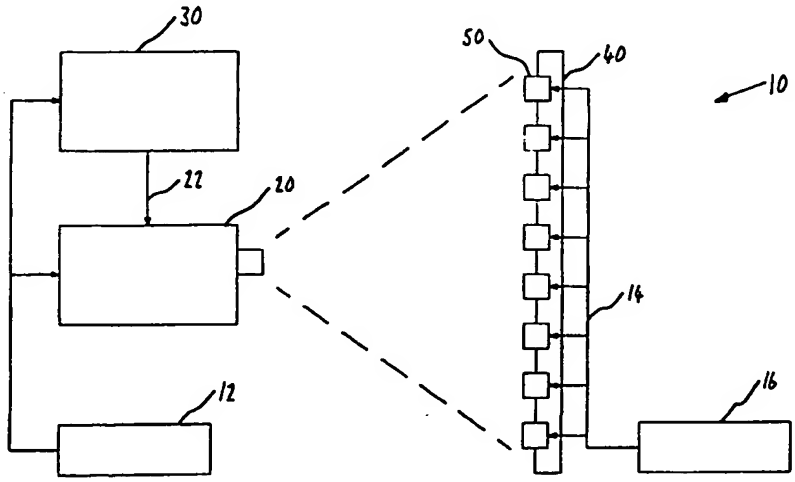

(57) Abstract: Image display apparatus (10) includes a projector (20), a computer (30) and a display screen (40). The projector (20) is controllable by the computer (30) to project a signal image of visible light, beam elements of which include digitally encoded information indicative of the colour and brightness of a corresponding pixel of an image that is to be displayed. The display screen (40) includes an array of elements (50) thereon. Each element (50) includes a photodiode (52), and integrated circuit (54) and three LEDs (56). Each element (50) is operable, when a beam element of the signal image is incident thereon, to sense light of the beam element, to decode the information the is indicative of the colour and brightness of the corresponding pixel of the image that is to be displayed, and to operate the LEDs such that they reproduce the colour and brightness of that pixel. In this way, the elements (50) display on the display screen (40) the image that is to be displayed.

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IMAGE DISPLAY APPARATUS WITH A PLURALITY OF LIGHT EMITTING COUPLED EACH TO A LIGHT GENERATING ELEMENT CONTROLLED BY THE FORMER ON THE BASIS OF A RECEIVED LIGHT COMMAND

This invention relates to image display apparatus.

Large, out-door display screens comprising light emitting diodes (LEDs) are known. Such screens include LEDs that are arranged so as to constitute pixels of a screen with a viewable area of the order of square metres. A typical LED display screen may contain over 200 000 LEDs, all of which are individually controlled by a central processing unit. Such screens are therefore expensive to design, develop and manufacture. They are also bulky, heavy and difficult to transport.

It is an object of this invention to address these problems

According to a first aspect of this invention there is provided image display apparatus for displaying an image, the apparatus including light signal emitting means and an image display assembly including a plurality of light signal receiving and image display elements, wherein each element comprises respective light signal receiving means and respective light generating means adjacent thereto, each light signal receiving means being operable to receive a respective light signal from the light signal emitting means and to control the respective light generating means in response to that light signal such that each element displays a respective pixel of the image.

The elements may be positioned on a member or members, thereby creating a display screen. The or each member may be fixed in position or moveable relative to the light signal emitting means. The or each member may be an automotive vehicle, such as a bus. The or each member may be a hat. Each element may be positioned on one end of a flexible rod, the other end being attached to a surface. The elements may be positioned randomly. The elements may be positioned in an array. Preferably, the elements are positioned such that they lie in the same plane and are uniformly distributed within a boundary. The

boundary may be substantially rectangular.

The light signals may be visible light. The light signals may be non-visible light. The light signals may be infra-red light.

The light signal receiving means of each element may include means operable to produce an intermediate electrical signal indicative of the respective light signal. The latter means may be a semi-conductor device and preferably it is a photodiode. The light signal receiving means of each element may include respective signal processing means operable to sense the respective intermediate electrical signal and to control the respective light generating means in response to the respective intermediate signal. The signal processing means may be an integrated circuit.

The light generating means of each element may be one or more light emitting diodes (LEDs). Where the light generating means of each element is a single LED the resulting image is monochromatic. The light generating means of each element may be a be a combination of one or more red LEDs, green LEDs and blue LEDs, thereby causing the image to be a colour image. The light generating means may be one or more strips of electro-luminescent material. The light generating means may be one or more incandescent lamps. The light generating means may be one or more discharge bulbs.

According to a third aspect of the present invention there is provided light signal emitting means for the image display apparatus.

The light signal emitting means may be operable to emit a respective light signal to the light signal receiving means of each element consecutively. The light signal emitting means may be operable to emit a respective light signal to the light signal receiving means of each element simultaneously. The light signals may be analogue light signals. The light signals may be digital light signals.

The light signal emitting means may comprise a laser. The laser may emit light signals with a wavelength of between 800 nanometres and 1 micrometre. The laser may emit light signals with a wavelength of between 635 nanometres and 670 nanometres.

The light signal emitting means may comprise one or more light signal emitting LEDs. The light signal emitting LEDs may be visible LEDs. The light signal emitting LEDs may be infra-red LEDs.

The light signal emitting means may comprise a projector. The projector may be focused so as to project a signal image onto the elements, the portion of the signal image that falls on each element being the respective light signal. The projector may be a conventional slide projector arranged to project an unchanging signal image from a slide.

The projector may be a projector that is arranged to project a changing signal image. The projector may be arranged to project a changing or unchanging signal image in response to a control signal from a computer. The projector may be a liquid crystal display (LCD) projector. The projector may be a digital light processing (DLP) projector. Preferably the projector is a DLP projector that includes a digital micro-mirror device (DMD).

Where the projector is a DLP projector that includes a DMD, the projector may be modified such that the frequency of the respective light signals emitted thereby is greater than that when un-modified. The DLP projector may be modified by including intermediate light encoding means between a light source of the projector and the DMD thereof, "between" being used in the sense that the intermediate light encoding means is in the path of light travelling from the source to the DMD. Preferably the intermediate light encoding means is arranged such that light of the light source is directed thereat or incident thereon and is operable to intermittently present light of the light source to the DMD such that the light presented thereby to the DMD is

encoded. The intermediate light encoding means may be operable to present an encoded "on command" and/or an encoded "off command" to the DMD. The DMD would preferably then be operable such that selected elemental mirrors thereof project the respective on command or the respective off command presented thereto so as to produce the respective light signal of the signal image.

The intermediate light encoding means may include a first rotatably mounted disc with circumferentially distributed light presenting portions and light blocking portions. The light presenting portions may be transparent; they may be reflective. The light blocking portions may be non-transparent; they may be non-reflective. The rotatably mounted disc may be rotatable in response to a disc control signal from control circuitry of the projector and/or from the computer. The intermediate light encoding means may include a second rotatably mounted disc with circumferentially distributed light presenting portions and light blocking portions, the second rotatably mounted disc being operably in a similar manner to the first rotatably mounted disc. The first rotatably mounted disc may be for providing an on command and the second rotatably mounted disc may be for providing an off command. The modified DLP projector may include a second light source for providing light that is incident on the second rotatably mounted disc.

According to a second aspect of this invention there is provided an image display assembly for use in the image display apparatus of the first aspect of this invention.

According to a third aspect of this invention there is provided a projector for use in the display apparatus of the first aspect of this invention.

A specific embodiment of this invention is now described by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of image display apparatus; and
Figure 2 is a schematic diagram of components of a display screen of the apparatus.

Figure 1 shows image display apparatus 10. The apparatus 10 includes a projector 20, a computer 30 and a display screen 40. The projector 20 is of the type that uses digital light processing and that employs a digital micro-mirror device to produce a greyscale or colour image with a resolution of, for example, 640x480 pixels in response to a control signal 22. This is achieved by the projector projecting a plurality of beam elements, each beam element corresponding to a respective pixel. Such projectors are commercially available and therefore need be described no further. A description of DLP DMD projectors may be found in the second edition (1997) of "Videowalls" by Robert S Simpson and as published by Focal Press. The computer 30 is a conventional personal computer and is connected to the projector 20 so as to supply the projector 20 with the control signal 22. Both the projector 20 and the computer 30 are provided with power from a power source 12.

The display screen 40 includes many elements 50. As will become apparent below, any number of elements 50 may be distributed across the screen 40 in any arrangement. However, in this case, the elements 50 are arranged in rows and columns of constant pitch so as to give a rectangular array with sides that have lengths generally in a ratio of 4:3, the longer sides being generally horizontal. For maximum resolution of the image that is to be displayed, the number of elements 50 should at least be the same as the number of pixels in that image. In this case, an array of 640x480 elements 50 is used. Each element 50 is a self-contained unit and is independent of all the other elements 50. The only external connection to each element 50 is a power supply 14, from a power source 16.

One element 50 is shown in greater detail in Figure 2. Specific language will now be used to describe this particular element 50, it being understood that this

element 50 is representative of all the elements 50. The element 50 includes a photodiode 52, an integrated circuit 54 and three LEDs 56. Of the three LEDs 56, one is red, one is green and the other is blue. It will be appreciated that in order to accurately reproduce the full spectrum of visible light using LEDs, it is often necessary to use two red LEDs, one green LED and one blue LED. However, for the sake of simplicity, only the aforementioned combination of three LEDs will be described, it being understood that the aforementioned combination of four LEDs may also be used. An output of the photodiode 52 is connected to an input of the integrated circuit 54. The photodiode 52 and the integrated circuit 54 are connected and arranged such that the photodiode 52 is operable to supply an intermediate signal 53 to the integrated circuit 54 representative of light that is incident on the photodiode 52. An output of the integrated circuit 54 is connected to the LEDs 56. The integrated circuit 54 and the LEDs 56 are connected and arranged such that the integrated circuit 54 is operable to control the instantaneous brightness of the light emitted by each LED 56 in response to the intermediate signal 53 from the photodiode 52.

In operation, and with reference to Figure 1, the computer 30 processes an image that is to be displayed, the image being stored in memory of the computer. The processing includes dividing the image that is to be displayed into a number of pixels, in this case 640x480, and producing therefrom a control signal to control the projector 20 such that the projector 20 projects a modulated signal image consisting of 640x480 signal image elements of digitally encoded information, in the form of light pulses. Each signal image element corresponds to a respective one of the pixels of the image that is to be displayed. The information in each signal image element relates to the colour and brightness of the respective pixel over time. The method of modulation may be any appropriate method that is known to the skilled addressee.

The computer 30 supplies the projector 20 with a control signal 22 to display the signal image. The projector 20 projects the signal image in response to the control signal 22. The signal image is composed of a 640x480 beam elements,

each beam element projecting a respective signal image element. The projector 20 is positioned and focused such that the signal image is incident on all the elements 50 of the screen 40 and so that each signal image element is incident on a respective element 50 and each element 50 has a respective one of the signal image elements incident upon it. This may be considered an idealised arrangement, with the position of each of the elements 50 coinciding with the position of a respective signal image element and is therefore the most economical distribution of elements 50 that will achieve maximum resolution of the image that is to be displayed.

The case of one such element 50 will again be considered. The light in the signal image element that is incident on the element 50 is sensed by the photodiode 52. The photodiode 52 is responsive to the light incident on it to supply an intermediate signal 53 to the integrated circuit 54. This intermediate signal 54 is indicative of the light of the respective signal image element and hence of the digitally encoded information contained therein. The integrated circuit 54 decodes the digitised information to give instructions for controlling the respective brightness of each of the three LEDs such that, in combination, the three LEDs recreate the colour and brightness of the corresponding pixel of the image that is to be displayed.

As described above, the elements 50 of the screen 40 are identical to, and autonomous of, each other. Each element 50 responds to the signal image element of the signal image that is incident on it, whatever element of the signal image that may be, and recreates the light characteristics of the corresponding pixel of the image that is to be displayed. Each element 50 will therefore operate if positioned anywhere where the signal image falls and is in-focus. It is therefore not necessary to have very accurately positioned elements 50 as is the case in the above example. There is also no requirement for a particular number of elements 50, although it will be appreciated that a maximum resolution of the image that is to be displayed will only be achieved by ensuring that each signal image element falls on one or more respective

elements 50. It may be that a random arrangement of a large number of elements 50, for example twice as many as the number of signal image elements, the elements 50 being contained within a rectangle with sides that have lengths in a ratio of 4:3, would be preferable to the arrangement of the above example. This would remove the need for accurate positioning of the signal image relative to the elements 50 so that each signal image element is incident on a respective element 50 and each element 50 has one respective signal image element incident on it. Furthermore, it is not necessary for the elements 50 to be in a fixed position relative to the projector 20 for an image to be displayed. Whenever an element 50 is in a position such that the light of a signal image element is incident on it, the element 50 will react by displaying the light characteristics of the corresponding pixel of the image that is to be displayed. Whether the elements 50 move or not, the signal image will always be fixed in space relative to the projector and so the image that is displayed will also always be fixed in space relative to the projector. This makes the apparatus suitable for a number of applications.

One application would be projecting images onto the sides of moving vehicles. This application is not shown in the drawings but may be understood with reference to the foregoing description and the drawings. The same reference numerals are used to denote like components. Projectors 20 are positioned above shops on one side of a street. Each projector receives a respective control signal 22 from a respective computer 30. Display screens 40 are mounted on sides of buses. The power supply 16 of each display screen 40 is an alternator driven by the engine of the respective bus. As a bus progresses along the length of the street, the elements 50 of the display screen 40 encounter a signal image of a first one of the projectors 20 that are mounted above the shops. As described above, each element 50 upon which is incident the light of a signal image element will display the light characteristics of the corresponding pixel of the image that is to be displayed. As the bus progresses, each element 50 has light incident upon it from a different signal image element and displays the light characteristics of the pixel of the image that is to

be displayed that corresponds thereto. In this way, the image that is to be displayed moves relative to the progressing bus, but is stationary relative to the first projector 20 and hence the shops. The image that is to be displayed will therefore "hover".

Another application would be projecting images onto hats worn be spectators at a stadium event. Elements 50 are attached to a hat. It is envisaged that each hat includes only one element 50, for the sake of simplicity. Although LEDs may be used as described previously, it is also envisaged that a strip of electro-luminescent material may be used instead. It will be appreciated that this would result in a monochrome image being displayed. The element 50 is powered by a battery pack. One such hat is worn by each of many spectators at a stadium event, such as a sporting event or a music concert. Projectors 20 are mounted on structure above the heads of those people wearing hats. The projectors 20 are supplied with a respective control signal 22 by a computer 30. The projectors 20 each project a respective signal image onto the elements 50 on the hats. As described above, the elements 50 respond by displaying the light characteristics of a pixel of the image that is to be displayed. The overall effect of all the elements 50 mounted on all the hats is to give the impression of displaying generally all of each of the images that are to be displayed, the images being stationary relative to the projectors 20 irrespective of movement of people wearing the hats.

A further application would be an installation art work. A respective element 50 is positioned on a top end of each of many flexible batons. The batons are attached at a bottom end of each of the batons to the floor. The batons are of a length that would cause their tops to be generally waist-high to an adult. For each baton, a respective power supply cable provides power from an external source 16, along the length of each baton, to the respective element 50 at the top. A projector 20 is mounted on structure above the flexible batons and, in response to a control signal 22 from a computer 30, projects a signal image that is focused on the elements 50. As described above, each element 50

displays the light characteristics of a pixel of an image that is to be displayed. People may participate in the installation by walking through the flexible batons, thereby causing batons to bend and the elements 50 thereon to move relative to the signal image so that those elements 50 display the light characteristics of a different pixel of the image that is to be displayed.

A still further application would be outdoor cinema. Many elements 50 are attached along lengths of supporting cable or line. Each length includes a respective power supply cable for the elements 50 attached therealong. The power supply cables are connected to a power supply 16. For ease of storage and transportation, the lengths are coiled side-by-side around a cylinder. During operation, the cylinder is supported above the ground and is rotated such that the lengths are uncoiled and hang downwards from the drum. In this way, the lengths, with elements 50 therealong, constitute a display screen. The projection of a signal image is as described previously.

Although it is preferred that the components and operation of the apparatus be as described above, it is nevertheless envisaged that alternative components may be used to similar effect. None of the following alternatives are shown in the drawings.

In the preferred embodiment described above, the integrated circuit 54 is operable to control the instantaneous brightness of the light emitted by each LED in response to the intermediate signal 53 from the photodiode 52. However, it is also envisaged that the integrated circuit 54 is operable to control the apparent brightness to a human viewer of the light emitted by each LED in response to the intermediate signal 53 by switching, at high frequency, each LED between a state in which it produces light of a maximum brightness and an off state. By varying the proportion of the length of time for which each LED is at maximum brightness, to the length of time for which it is off, an apparent brightness is perceived by the human eye, it being appreciated that the human eye integrates a rapidly changing brightness over time to give an

apparent brightness. Such high-frequency switching between a single on state and an off state is often referred to as "Pulse Width Modulation".

Instead of transmitting a signal image of digitally encoded information, an analogue signal image may be transmitted. Each signal image element would comprises a single light wave, the wavelength of which would be used to convey the necessary information about the colour and brightness of the corresponding pixel of the image that is to be displayed. More information may be conveyed simultaneously by each signal image element comprising more than one light wave, each light wave having a different wavelength. The integrated circuit of each element would be arranged to control the respective brightness of each of the three LEDs in response to the intermediate analogue signal produced by the respective photodiode as a result of the light of the respective incident signal image element of the analogue signal image. A disadvantage of an analogue signal image would be that background light might interfere with the functioning of the apparatus to a greater extent than would be the case if a digital signal image were used.

As stated above, each integrated circuit is operable to control the brightness of each of the respective LEDs in response to the digitally encoded information contained within a respective signal image element, such that the LEDs display the colour and brightness of a corresponding pixel of the image that is to be displayed. However, it is envisaged that each integrated circuit may be operable to maintain the brightness of each of the respective LEDs, such that they continue to display the colour and brightness of the corresponding pixel, until the integrated circuit decodes subsequent digitised information contained within a subsequent respective signal image element. The integrated circuit would then control the brightness of each of the respective LEDs in response to that subsequent information. It will be appreciated that this would tend to reduce any flickering of the image that is to be displayed. It is also envisaged that if the integrated circuit receives no digitised information within a given time period, it may extinguish the respective LEDs. It will be appreciated that by

specifying a time period of several seconds, interesting visual effects may be achieved in the above-mentioned applications.

Although the signal image is composed of visible light in the preferred embodiment described above, it is also envisaged that the signal image may be composed of non-visible light, such as infra-red light. An advantage of using infra-red light might be that interference from background radiation may be reduced. The use of infra-red light might therefore particularly lend itself to an analogue signal image.

An alternative to simultaneously projecting an entire signal image onto the display screen (ie "parallel" projection) would be to project a respective signal to each of the elements consecutively (ie "series" projection). This may be achieved using a laser. In such an arrangement, the laser would be focused such that its beam covers an area the size of one pixel of the image that is to be displayed on the display screen. The laser would advance one pixel at a time along a row of pixels emitting either pulses of digitally encoded information or analogue waves, before moving to another row and repeating this operation. In this way, the laser would scan across the display screen and build up a complete image signal. One advantage of using a laser might be that it has a narrow band of transmission, thereby making it well suited to transmitting information. Furthermore, the intensity of the light emitted by a laser is generally greater than that emitted by a DLP DMD projector. This would tend to allow the signal image to be successfully projected over a greater distance than would be possible with the DLP DMD projector. The laser may therefore be positioned further away from the elements than would be possible with the projector. A disadvantage of using a laser might be that it can only be used in conjunction with series projection of the image signal. Series projection would have to be performed at a very high frequency in order to update the image that is to be displayed quickly enough for there to be no flickering apparent to the human eye. In order to function at this high frequency, the components of the apparatus may be more expensive than those

that would be used in apparatus employing parallel projection.

Alternative projectors are also envisaged. A liquid crystal display (LCD) projector would be a less expensive alternative to a DLP DMD projector. However, LCD projectors are generally unable to project light with as great an intensity as that projected by a DLP DMD projector. An LCD projector would therefore have to be positioned closer to the elements than would a DLP DMD projector. It is envisaged that the LCD projector may be used to project either a digital or an analogue signal image. Slide projectors using photographic-type slides may be used to project an unchanging analogue signal image, which would be converted by the elements into a stationary image that is to be displayed.

In the preferred embodiment described above, rapid switching of elemental mirrors of the digital micro-mirror device of a conventional DLP DMD projector is relied upon to produce the signal image elements of digitally encoded information. However, it is envisaged that a DLP DMD projector may be modified. The following modification would be of use primarily in apparatus where brightness of the LEDs is controlled using pulse width modulation (PWM) as previously described. A rotatably mounted disc with circumferentially alternate transparent and non-transparent segments may be included in the projector between a light source and the digital micro-mirror device. This disc would be rotatable in response to a disc control signal from control circuitry of the projector or from the computer, such that a digitally encoded "on command" is directed towards the micro-mirror. This on command may be an on command specific to LEDs of a certain colour in the case of a colour display screen, or it may be a general on command in the case of a monochrome display screen. The elemental mirrors of the micro-mirror would be arranged so that the on command is contained within desired signal image elements. The desired signal image elements would be those that correspond to pixels for which the on command is appropriate in order to achieve the required apparent brightness by PWM of the relevant colour in the case of a

colour screen, or of the colour in a monochrome screen. The disc would also be rotatable in response to the disc control signal such that a digitally encoded "off command" is directed towards the micro-mirror. This would be selectively projected in a similar manner.

It is envisaged that the projector may be further modified to include a separate light source and a second rotatably mounted disc similar to the first. The first light source and wheel would be dedicated to providing on commands, and the second light source and wheel would be dedicated to providing off commands. It will be appreciated that this will increase the frequency with which commands may be projected.

It is envisaged that the projector may be still further modified to include further similar rotatably mounted wheels positioned between each of the first and second wheels and the micro-mirror. Each further wheel would be operated in combination with a respective one of the first and second wheels to reduce the time taken to produce the respective on or off command.

It is envisaged that the projector may be still further modified to replace one or both of the first and second light sources with a stroboscopic light source, such as a xenon discharge tube. The stroboscopic light source would be operable to flash in response to a strobe control signal from control circuitry of the projector or from the computer. It will be appreciated that this would further reduce the time taken to produce the respective on or off command. It is envisaged that one or more stroboscopic light sources may be used in combination with, or in place of, the rotatably mounted wheel or wheels.

In performing any of the aforementioned modifications to a DLP DMD projector, or even in putting into practice the preferred embodiment, it is envisaged the corresponding modifications may have to be made to software stored in a memory of the projector such that the projector is operable to project the signal image in response to the control signal.

An array of signal emitting LEDs may be used in preference to a projector. In such an array, one signal emitting LED would be provided for each signal image element of the signal image and lenses would be provided to focus the output of the signal emitting LEDs onto the elements of the screen. It is envisaged that the signal emitting LEDs would produce either a digital or an analogue signal image and that this signal is composed of either visible light or infra-red light.

CLAIMS

1. Image display apparatus for displaying an image, the apparatus including light signal emitting means and an image display assembly including a plurality of light signal receiving and image display elements, wherein each element comprises respective light signal receiving means and respective light generating means adjacent thereto, each light signal receiving means being operable to receive a respective light signal from the light signal emitting means and to control the respective light generating means in response to that light signal such that each element displays a respective pixel of the image.

2. An image display apparatus according to claim 1 wherein the elements are positioned on one or more members, thereby creating a display screen.

3. An image display apparatus according to claim 2 wherein at least one member is moveable relative to the light signal emitting means.

4. An image display apparatus according to claim 3 wherein at least one member is an automotive vehicle.

5. An image display apparatus according to claim 3 wherein at least one member is a hat.

6. An image display apparatus according to claim 1 wherein each element is positioned on one end of a flexible rod, the other end being attached to a surface.

7. An image display apparatus according to any one of the preceding claims wherein the elements are positioned randomly.

8. An image display apparatus according to any one of claims 1 to 6 wherein the elements are positioned in an array.

9. An image display apparatus according to any one of the preceding claims wherein the light signals are of visible light.

10. An image display apparatus according to any one of claims 1 to 8 wherein the light signals are of non-visible light.

11. An image display apparatus according to claim 10 wherein the light signals are of infra-red light.

12. An image display apparatus according to any one of the preceding claims wherein the light signal receiving means of each element includes means operable to produce an intermediate electrical signal indicative of the respective light signal, and the light signal receiving means of each element includes respective signal processing means operable to sense the respective intermediate electrical signal and to control the respective light generating means in response to the respective intermediate signal.

13. An image display apparatus according to claim 12 wherein the light signal receiving means is a semi-conductor device.

14. An image display apparatus according to claim 12 or 13 wherein the signal processing means is an integrated circuit.

15. An image display apparatus according to any one of the preceding claims wherein the light generating means of each element is one or more light emitting diodes (LEDs).

16. An image display apparatus according to claim 15 wherein the light generating means of each element is one or more LEDs arranged such that the resulting image is substantially monochromatic.

17. An image display apparatus according to claim 15 wherein the light

generating means of each element is a combination of one or more red LEDs, green LEDs and blue LEDs such that the image is a colour image.

18. An image display apparatus according to any one of claims 1 to 14 wherein the light generating means are one or more strips of electro-luminescent material.

19. An image display apparatus according to any one of claims 1 to 14 wherein the light generating means are one or more incandescent lamps.

20. An image display apparatus according to any one of claims 1 to 14 wherein the light generating means are one or more discharge bulbs.

21. An image display apparatus according to any one of the preceding claims wherein the light signal emitting means is operable to emit a respective light signal to the light signal receiving means of each element consecutively.

22. An image display apparatus according to any one of claims 1 to 20 wherein the light signal emitting means is operable to emit a respective light signal to the light signal receiving means of each element simultaneously.

23. An image display apparatus according to any one of the preceding claims wherein the light signals are analogue light signals.

24. An image display apparatus according to any one claims 1 to 22 wherein the light signals are signals of digitally encoded information.

25. An image display apparatus according to any one of the preceding claims wherein the light signal emitting means includes a laser.

26. An image display apparatus according to claim 25 wherein the laser emits light signals with a wavelength of between 800 nanometres and 1 micrometre.

27. An image display apparatus according to claim 25 wherein the laser emits light signals with a wavelength of between 635 nanometres and 670 nanometres.

28. An image display apparatus according to any one of claims 1 to 24 wherein the light signal emitting means includes one or more light signal emitting LEDs.

29. An image display apparatus according to any one of the preceding claims wherein the light signal emitting means includes a projector.

30. An image display apparatus according to claim 29 wherein the projector is operable to project a signal image onto the elements, the portion of the signal image that falls on each element being the respective light signal.

31. An image display apparatus according to claim 29 or 30 wherein the projector is arranged to project a changing signal image.

32. An image display apparatus according to claim 29 or claim 30 wherein the projector is a conventional slide projector arranged to project an unchanging signal image from a slide.

33. An image display apparatus according to any one of claims 29 to 31 wherein the projector is arranged to project the signal image in response to a control signal from a computer.

34. An image display apparatus according to claim 33 wherein the projector is a liquid crystal display projector.

35. An image display apparatus according to claim 33 wherein the projector is a digital light processing projector.

36. An image display apparatus according to claim 33 wherein the projector is a digital light processing projector that includes a digital micro-mirror device.

37. An image display apparatus according to any one of claims 34 to 36 wherein the projector is operable such that each pixel of the signal image is a respective light signal of digitally encoded information.

38. An image display apparatus according to claim 37 when appended to claim 36, or claim 36 wherein, the projector is modified such that it includes intermediate light encoding means between a light source of the projector and the digital micro-mirror device thereof, the intermediate light encoding means being arranged such that light of the light source is directed thereat and being operable to intermittently present light directed thereat to the digital micro-mirror device such that the light presented to the digital micro-mirror device is encoded.

39. An image display apparatus according to claim 38 wherein the intermediate light encoding means is operable to present an encoded "on command" and/or an encoded "off command" to the digital micro-mirror device, the digital micro-mirror device being operable such that selected elemental mirrors thereof project the respective on command or the respective off command presented thereto so as to produce the respective light signal of the signal image.

40. An image display apparatus according to claim 38 or claim 39 wherein the intermediate light encoding means includes a first rotatably mounted disc with circumferentially distributed light presenting portions and light blocking portions, the rotatably mounted disc being rotatable in response to a disc control signal from control circuitry of the projector and/or from the computer such that the light presenting portions and the light blocking portions are intermittently positioned between the light source and the micro-mirror device.

41. An image display apparatus according to claim 40 wherein the intermediate

light encoding means includes a second rotatably mounted disc with circumferentially distributed light presenting portions and light blocking portions, the second rotatably mounted disc also being operable to intermittently present light directed thereat to the micro-mirror device.

42. An image display apparatus according to claim 41 wherein the first rotatably mounted disc is for presenting an on command and the second rotatably mounted disc is for presenting an off command.

43. An image display apparatus according to claim 41 or claim 42 wherein the modified digital light processing projector includes a second light source for providing light that is directed at the second rotatably mounted disc.

44. An image display apparatus according to, claim 36, claim 37 when appended to claim 36, or any one of claims 38 to 43, wherein the projector includes a stroboscopic light source.

45. An image display assembly as defined in any of the preceding claims.

46. Light signal emitting means as defined in any of the preceding claims

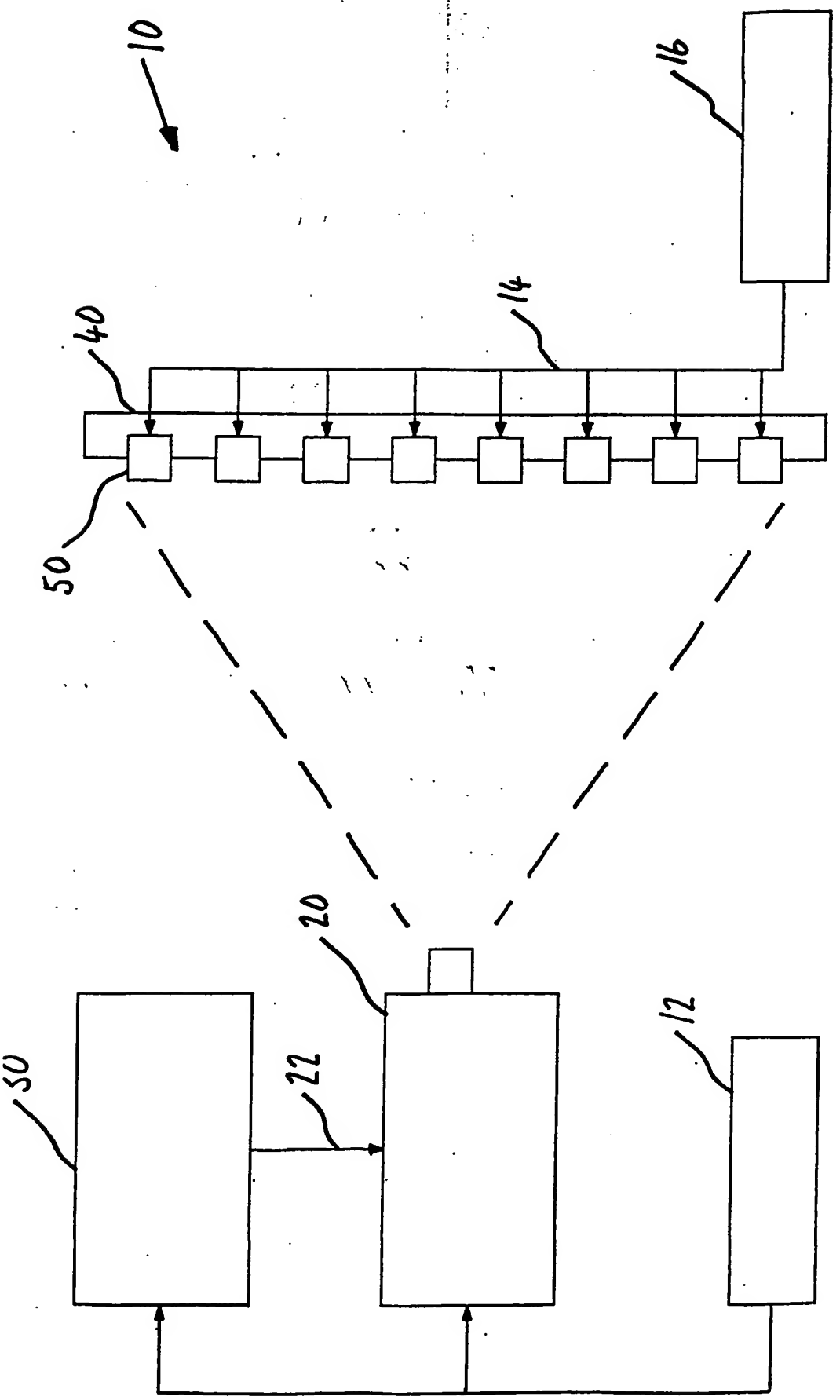

FIG. 1

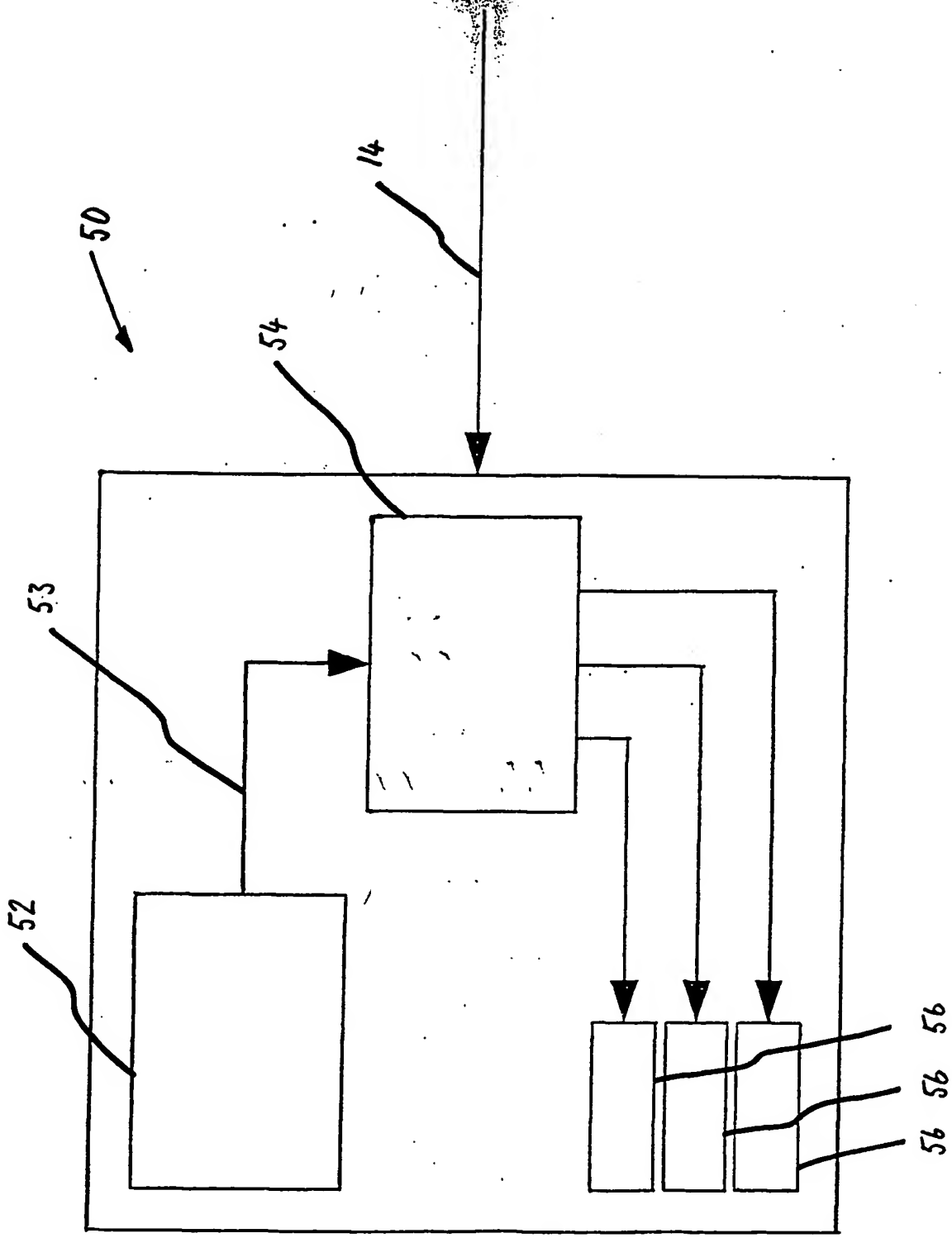

FIG. 2

INTERNATIONAL SEARCH REPORT

PCT/GB 01/04954

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G09G3/00 G09G3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G09G G06F G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 093 852 A (OLIVE GRAHAM ET AL) 6 June 1978 (1978-06-06)	1,2,8,9, 12,13, 18,21, 25,45,46
Y	* abstract * column 1, line 4 -column 2, line 7 column 2, line 38 -column 4, line 11; figures 1-4	3,5-7, 15-17
X	FR 2 652 185 A (THOMSON CSF) 22 March 1991 (1991-03-22)	1,2, 8-14, 18-20, 23-25, 28,45,46
	* abstract * page 1, line 1 - line 10 page 4, line 11 -page 8, line 28; figures 1-4	

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
22 February 2002	04/03/2002

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 463 468 A (TAKANASHI ITSUO ET AL) 31 October 1995 (1995-10-31) * abstract * column 1, line 10 - line 44 column 2, line 7 - line 22 column 7, line 60 -column 10, line 26; figures 1,13,15,16 column 11, line 40 - line 46; figures 2-4 column 22, line 11 - line 20; figure 24 column 24, line 58 -column 26, line 43; figures 27-35	1,8,9, 15,17, 23,25, 28,45,46
Y	US 5 921 674 A (KOCZI WOLFGANG) 13 July 1999 (1999-07-13) * abstract * column 1, line 34 -column 2, line 38 column 2, line 58 -column 4, line 54; figures 1-5C	3,5-7, 15-17
A	US 5 128 660 A (DEMOND THOMAS W ET AL) 7 July 1992 (1992-07-07) * abstract * column 6, line 22 - line 66; figure 1 column 7, line 49 -column 8, line 5; figure 2 column 13, line 19 -column 14, line 30; figure 5	29-31, 33-40
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 581 228 A (MARIE JACQUES) 31 October 1986 (1986-10-31) * abstract * page 1, line 1 -page 2, line 11 page 3, line 1 -page 4, line 4 page 10, line 1 - line 8; figure 1 page 11, line 1 - line 6; figure 4 page 12, line 1 - line 4 page 18, line 1 -page 20, line 26; figures 2,3 page 22, line 1 - line 4 page 24, line 5 -page 25, line 2 page 25, line 17 -page 28, line 10; figures 8,9 page 29, line 20 -page 30, line 21	1,2, 8-12,21, 22,24,29

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